AMATERASによって観測された太陽電波IV型バースト中の zebra patternの偏波特性

Polarization characteristics of zebra pattern in type IV solar radio bursts observed with AMATERAS

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Type IV burst is a continuum radio emission that emanates from closed magnetic structures and often exhibits a variety of complex spectral fine structures. Since these fine structures are thought to be caused by some inhomogeneities or modulations of wave generation and/or radio propagation processes, their spectral characteristics have significant information about plasma parameters and plasma processes in the solar corona. Among them zebra patterns (ZP) has a characteristic spectral pattern with nearly parallel drifting narrowband stripes of enhanced emission superimposed on the background type IV burst. They are often observed in the meter to decimeter wave band mostly in the post flare phase. Although a large number of observational and theoretical studies have been devoted to this phenomenon since the first detection of them in the end of 1950's, generation mechanisms for ZP have been still discussed. The purpose of this study is to investigate the generation and propagation processes of ZP by evaluating their scenarios suggested in previous studies. For this purpose, we analyzed an event of June 21, 2011 observed with IPRT/AMATERAS in particular on polarization characteristics and their frequency dependences. AMATERAS is a radio spectro-polarimeter developed by Tohoku University (Iwai et al. 2012), which can distinguish fine spectral structures of solar radio bursts with high time and frequency resolutions (for both right-handed and left-handed polarized components) in the metric wavelength range, and enables us to perform a detailed analysis of spectral fine structures like ZP. Since the frequency

dependence of polarization has been hardly observed because of an instrumental limit, it is meaningful to analyze the high resolution polarization data observed with AMATERAS.

In the event of June 21, 2011, successive type IV bursts were observed in association with a C7.7 class flare. ZP appeared in a frequency range of about 160-210 MHz with about 30 stripes and was enhanced in rapidly drifting envelopes like type III bursts. These spectral characteristics can be reasonably explained with a model based on the Double Plasma Resonance (DPR), one of the most popular models for ZP phenomenon. ZP appeared in both polarized component and it was stronger in the RCP. The polarization characteristics were investigated precisely in terms of three characteristics. We listed them below with the analyzed results. 1. Degree of polarization: The observed ZP was strongly polarized in right-handed and its degree of polarization is expected to be about 50-70 %. This is consistent with the spatially resolved observation: the mode of ZP corresponded to *o*-mode (Chen et al. 2011). The degree of polarization varied little over the whole frequency and time range of ZP. 2. Delay between the RCP and LCP: Considerable delay of LCP relative to RCP was detected. The delay of LCP was about 50 ms and a little frequency dependence have been seen; increased with the increasing frequency. 3. Frequency shift between RCP and LCP: The frequency shift between two polarizations was detected and it ranges from about -91 kHz to 150 kHz depending on the frequency. However these shifts contain some ambiguity due to the delay and frequency drift of ZP stripes. From the observation results described above, the original emission mode and generation and propagation process of RCP and LCP ZP waves were investigated. The original emission mode is expected to be *o*-mode from the dominance of RCP and from the magnetic polarity of expected source region in the leading sunspot of the active region. Then the LCP is considered to be generated by some depolarization processes. As the result of examination on some theoretical processes for explaining the delay and depolarization, the most plausible scenario is suggested as follows; the completely polarized emission (*o*-mode) generated at DPR levels was depolarized due to the scattering by low frequency waves at the different height in a flare loop depending on its frequency, and then the generated *x*-mode was delayed due to the slower group velocity during the propagation in the dense plasma near the source. Confirmation of this scenario at the more reliable level is a future subject. In order to carry out this, it is important to evaluate the effect of the frequency drift of ZP stripes.